CRITERION 725

DELUGE SPRINKLER SYSTEMS

SIGNATURES

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RECORD OF REVISIONS

Revision No.	Date	Description
0	04/30/98	Initial Issue
1	09/12/02	This revision reflects the conversion from a WordPerfect document into a Microsoft Word document and additional clarification on how to develop criteria. This revision includes: • The addition of a Table of Contents • The use of Basis Statements in Sections 6, 7, and 9 • Revision to Section 9, "Required Documents" • Further clarification in the use of references.
2	8/04/03	Revise Sections 6.2, 6.3, and 6.4 to clarify requirements of NFPA 25. Change of reference of DOE O 4330.4B to DOE O 433.1

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CRITERION 725

DELUGE SPRINKLER SYSTEMS

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for operation, maintenance and inspection of deluge sprinkler systems at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), "Operations and Maintenance Manual."

Implementation of this Criterion satisfies DOE Order 430.1A (Ref 10.2) for the subject equipment / system. DOE Order 430.1A (Ref 10.2) "Life Cycle Asset Management," Attachment 2 "Contractor Requirements Document," Paragraph 2, Sections A through C, which in part requires UC to "…maintain physical assets in a condition suitable for their intended purpose," and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

2.0 SCOPE

The scope of this Criterion includes the routine inspection, testing and preventive and predictive maintenance of LANL deluge sprinkler systems. This Criterion does not address corrective maintenance actions required to repair or replace equipment. This Criterion applies to all LANL organizations owning deluge sprinkler systems.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DOE	Department of Energy
FDC	Fire Department Connections(s)
FWO	Facility Waste Operations
ITM	Inspection, Testing and Maintenance
LIR	Laboratory Implementation Requirement
LPR	Laboratory Performance Requirement
MSE	Maintenance and Systems Engineering

NFPA	National Fire Protection Association
O&M	Operations and Maintenance
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
SSS	Support Services Subcontractor
UC	University of California

3.2 Definitions

Deluge Sprinkler System. A sprinkler system employing open sprinklers that are attached to a piping system that is connected to a water supply through a valve that is opened by the operation of a detection system installed in the same areas as the sprinklers. When this valve opens, water flows into the piping system and discharges from all sprinklers attached thereto. Note that a deluge spray system utilizes spray nozzles, so is not equivalent to a deluge sprinkler system.

Management Level Determination (ML1, ML2, ML3, ML4). A classification system for determining the degree of management control applied to facility work. See LIR 230-01-02 for definitions of each ML level.

4.0 RESPONSIBILITIES

4.1 FWO- Maintenance and Systems Engineering (MSE)

4.1.1 FWO-MSE is responsible for the administrative content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

Basis: LIR 301-00-01.11; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

4.1.2 FWO-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 FWO-Fire Protection (FWO-FIRE)

4.2.1 FWO-FIRE is responsible for the technical content of this Criterion and monitoring the proper implementation across the Laboratory.

4.2.2 FWO-FIRE shall provide technical assistance to support implementation of this Criterion.

4.3 Facility Manager

4.3.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.3.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.4 Group Leader

4.4.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document, which are under their jurisdiction.

4.4.2 Responsible for system performance and subsequent replacement or refurbishment of assigned PP&PE.

4.5 Authority Having Jurisdiction (AHJ) – LANL Fire Marshal

4.5.1 The AHJ is responsible for providing a decision on a specific technical question regarding this Criterion.

4.5.2 The LANL Fire Marshal is the approval authority for any exceptions or variances to this Criterion.

4.6 Support Services Subcontractor (SSS)

4.6.1 Responsible for providing ITM of the fire protection systems addressed in this Criterion at the request of the responsible Facility Manager.

4.6.2 Responsible for coordinating work with operating group and Facility Manager to conduct ITM in the affected area.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

5.2.1 Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances and exceptions to these requirements shall be prepared and submitted to FWO-MSE in accordance with LIR 301-00-02 (Ref. 10.4), "Variances and Exceptions to Laboratory Operations Requirements," for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section. Variances and exceptions to this Criterion shall be approved by the LANL Fire Marshal.

6.1 Operations Requirements

The deluge sprinkler system shall be operational at all times. The deluge sprinkler system is deemed operational when the following conditions exist:

- the system control valve is open.
- an adequate water supply is available (with appropriate water pressure and quantity – compare to previous satisfactory test results)
- the water flow alarm is operational.
- the deluge system fire detection subsystem (typically heat detection or pilot head detection) is in service and connected to the deluge valve activation device.
- sprinklers are unobstructed (ref. NFPA 13, Section 5-6).
- all piping, fittings, hangers, sprinklers, and other components are in their proper locations and in good condition.
- sprinklers are a sufficient horizontal distance from ceiling height obstructions so that sprinkler spray pattern is not significantly obstructed (use engineering judgment and refer to NFPA 13 for restrictions).
- pendent and upright sprinklers are at least 4" from wall.
- continuous or non-continuous obstructions such as storage and partial-height partitions are at least 18" below sprinkler deflectors.
- where fixed continuous or non-continuous obstructions beneath sprinklers are more than 48" wide (ex., scaffold, platforms, ductwork, cable trays, cutting tables), sprinklers must be provided underneath.

Basis: NFPA 13, 1999 Edition Standard For Installation of Sprinkler Systems and NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection.

6.2 Inspections

6.2.1 Daily Inspections

Valve enclosure heating equipment, for valves subject to freezing, shall be inspected DAILY during cold weather for its ability to maintain a minimum temperature of at least 4 degrees C (40 degrees F).

EXCEPTION: Where riser enclosures are equipped with low temperature alarms, visually inspect riser enclosure heating equipment WEEKLY.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.2 Quarterly Inspections:

Sprinkler pressure reducing control valves shall be inspected quarterly to verify that the valves are in the following condition:

- In the open position.
- Not leaking.
- Maintaining downstream pressure in accordance with the design criteria.
- In good condition, with handwheels installed and unbroken.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.2.3 Semi-Annual Inspection(s) [twice a year]

(a) Visually inspect the system hydraulic nameplate, if provided, to ensure it is securely attached and legible.

NOTE: The nameplate may contain hydraulic calculation information applicable to the sprinkler system. If the sprinkler riser does not have a nameplate, this requirement is not applicable.

(b) Visually inspect system valves to verify the following:

- They are accessible.
- They are in their proper position.
- They are in good condition and free of external leaks.
- They are sealed, locked, or supervised.
- They are properly identified.

(c) Visually inspection system alarm devices to verify that they are accessible, in good condition, and free of damage.

(d) Visually inspect system gauges to verify that they have up-to-date calibration and that they are displaying normal supply-side and system-side pressures.

(e) Inspect deluge valve to verify the following:

- the valve is free of physical damage.
- trim valves are in their proper position.
- there is no leakage from the valve seat.
- electrical components are in service.

(f) Visually inspect FDCs to verify the following:

- FDCs are visible and accessible,
- Couplings or swivels are undamaged and rotate smoothly,

- Plugs and caps are in place and undamaged,
- Interior of the connection is unobstructed and valve clapper is operational over its full range when the FDC is plugged or if caps are out of place,
- Gaskets are in place and in good condition,
- Identification signs are in place,
- Check valve is not leaking,
- The automatic drain valve is in place and operating properly,
- Components are cleaned, repaired, or replaced as necessary in accordance with the manufacturer's instructions, and
- FDC clapper(s) is in place and operating smoothly.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract. DOE-Approved Equivalency to NFPA 25.

6.2.4 Annual Inspection

(a) Visually inspect the entire system (piping and fittings, seismic bracing, hangers, sprinkler heads including spares, sprinkler obstructions, and unprotected spaces) to verify they are operational and to ensure the system is free of mechanical damage.

- Pipe, fittings, hangers and seismic braces installed in concealed spaces such as above suspended ceilings shall not require inspection.
- Pipe and hangers installed in areas that are inaccessible for safety considerations due to process operations shall be inspected during each scheduled shutdown.

(b) Inspect the interior of the deluge valve when the system is trip-tested.

(c) The supply of spare sprinklers shall be inspected for the proper number and type of sprinklers (at least 6 spare sprinklers proportionally representative of the types and temperature ratings of the system sprinklers). [A sprinkler wrench must be provided for each type of sprinkler.]

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract

6.2.5 5-Year Inspection

(a) Internally inspect all check valves to verify components operate properly, move freely, and are in good condition. Clean, repair, or replace the internal components as necessary in accordance with the manufacturer's instructions.

(b) Internally inspect strainers, filters, and restricted openings every 5 years, unless tests indicate that a more stringent frequency is required.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract

6.3 Testing

6.3.1 Quarterly Testing

Systems where the sole water supply is through a back flow preventer and/or pressure reducing valves, the main drain test of at least one system downstream of the device shall be conducted on a quarterly basis.

6.3.2 Semi-Annual Testing

- Conduct a main drain test.
- Test the system alarms.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.3.3 Annual Testing

(a) Fully close and reopen the system control valve(s).

(b) If it is operationally feasible, trip test each deluge during warm weather in accordance with the manufacturer's instructions.

- Observe water discharge patterns from all open sprinklers to ensure patterns are not impeded by plugging.
- Observe sprinklers to ensure they are properly positioned. When obstructions occur, clean the piping and sprinklers, and retest the system.
- Record pressure readings at the hydraulically most remote sprinkler to ensure the water flow has not been blocked. Record a second pressure reading at the deluge valve to ensure an adequate water supply is available. Compare these readings to the hydraulic design pressures to ensure the original system design is met and the water supply is adequate.

- Where the hydraulically most remote nozzle or sprinkler is inaccessible, sprinklers shall be permitted to be checked visually without taking a pressure reading on the most remote nozzle or sprinkler.

EXCEPTION: In protected properties where water cannot be discharged into the piping or protected area for test purposes, conduct the trip test so it will not require discharge into the piping (see item (c) below).

(c) When water cannot be discharged into the piping for test purposes, a main drain test shall be conducted to verify availability of water to the deluge valve and to determine if there has been a change in the condition of the water supply piping and control valves.

NOTE: Maintain records that indicate when the deluge valve was last tripped, the actual tripping time, and the individual and organization conducting the test. These records shall be kept in a location that is readily available for viewing by the AHJ.

(d) Test low temperature alarms at the start of the heating season, if installed.

(e) Operate manual actuation devices.

(f) Pressure reducing or relief valves – A partial flow test adequate to move the valve from its seat shall be conducted annually.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.3.4 5-Year Testing

(a) Replace gauges or test by comparison to a calibrated gauge.

(b) Pressure reducing or relief valves: A full-flow test shall be conducted at 5-year intervals and shall be compared to previous test results.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems, Chapter 12. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.4 Maintenance

6.4.1 General

Maintain the system in operating condition. Repair or replace any components failing a test or inspection in accordance with the manufacturer's instructions.

6.4.2 Sprinklers

(a) Replacement sprinklers shall have the proper characteristics for the application intended. These characteristics include proper:

- style,
- orifice size and K factor,
- coating (if any),
- deflector type, and
- design requirements.

(b) Use only new, listed sprinklers to replace existing sprinklers.

(c) Facility and/or LANL's SSS shall keep a supply of spare sprinklers (never fewer than six) on the premises so that any sprinklers that have operated or been damaged in any way can be promptly replaced. A minimum of two sprinklers of each type and temperature rating shall be kept.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract

6.4.3 Sprinkler Systems and Yard Main Piping

Conduct an obstruction investigation for sprinkler systems and yard main piping whenever any of the following conditions exist:

- plugged piping in sprinkler systems dismantled during building alterations are discovered,
- failure to flush yard piping or surrounding public mains following new installations or repairs,
- record of broken public mains in the vicinity exists,
- abnormally frequent false tripping of a dry pipe valve(s),
- There is reason to believe that the sprinkler system contains sodium silicate or highly corrosive fluxes in copper systems,
- a system has been supplied with raw water via the fire department connection,
- pinhole leaks are found, and
- there is a 50-percent increase in the time it takes water to travel to the inspector's test connection from the time the valve trips during a full flow trip test of a dry pipe sprinkler system when compared to the original system acceptance test.
- discharge of obstructive materials is found during routine water flow tests.

- foreign materials are discovered in fire pumps, dry pipe vlaves, or check valves.
- heavy discoloration of water during drain tests or plugging of inspectors test connection is found.
- plugging of sprinklers is discovered.
- following repair of water mains in the vicinity.
- a system is returned to service after an extended period (normally greater than 1 year).

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract

6.4.4 Control Valves

- Annually lubricate the operating stems of outside screw and yoke (OS&Y) valves. Then close and reopen the valve completely to test its operation and distribution of the lubricant. Graphite lubricant is recommended.

NOTE: Do not apply grease or other sealing materials to valve seating surfaces.

- Clean, repair, or replace internal components as necessary in accordance with the manufacturer's recommendations.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.4.5 Deluge Valves

- During the annual trip test, thoroughly clean the interior and replace or repair any parts as necessary.

NOTE: Interior cleaning and parts replacement or repair shall be permitted every 5 years for valves that can be rest without removal of a faceplate.

- Drain the low points in deluge systems after operation and before the onset of freezing weather.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract

6.5 Impairments and Modifications

If one or more of the operability requirements listed in Section 6.1.1 are not maintained, follow the actions outlined in Criterion 733, Fire Protection System Impairment Control Program.

6.5.1 Inspection Following an Impairment or Modification

Visually inspect the system before returning it to service following system impairment or modification. See Appendix A.

6.5.2 Testing Following Impairment or Modification

6.5.3 The following testing will be performed following system impairment or modification and prior to returning the system to service:

- Check the water supply to verify an adequate pressure and volume of water is available at the system connection.
- Test the main drain to verify the control valve is open.
- Test using the alarm bypass connection to verify the system local audible alarm and/or alarm signal to the Central Alarm Station (CAS) will operate within the required time.
- Flush (if required by NFPA 13) and hydrostatically test any repaired or modified parts of the system (pressure boundary or flow path).
- Test initiation system (detection, pull stations) per Fire Alarm Criterion.

Basis: NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems. Compliance with this NFPA code is required per Appendix G of the UC contract.

6.5.4 Operational testing and alarm verification

Operational testing and alarm verification will be conducted by SSS personnel, in compliance with LIR 402-910-01, Section 6.0.

Basis: LIR 402-910-01, LANL Fire Protection Program

7.0 RECOMMENDATIONS AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

None available.

7.2 Maintenance Recommendations

Persons other than SSS Fire Protection Maintenance personnel may conduct visual inspection requirements identified in this document.

Basis: LIR 402-910-01.4, LANL Fire Protection Program

8.0 GUIDANCE

8.1 Operations Guidance

No operations guidance available.

8.2 Maintenance Guidance

No maintenance guidance available.

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained by the FM for deluge sprinklers to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	**ML 1**	**ML 2**	**ML 3**	**ML 4**
Deluge Sprinkler System Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X	X	X
Deluge Sprinkler System Equipment Problems				
Failure Dates	X	X	X	X
Failure Root Cause	X	X	X	X
Deluge Sprinkler Inspection Results (per this Criterion)				
Inspection Date	X	X	X	X
SSC Condition	X	X	X	X

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; "Maintenance activities, equipment problems, and inspection and test results are documented."

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

10.1 LIR 230-05-01.0, Operation and Maintenance Manual.

10.2 DOE O 430.1A, Attachment 2 "Contractor Requirements Document" (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.

10.3 DOE Order 433.1, Maintenance Management Program for DOE Nuclear Facilities

10.4 LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.

10.5 LPR 230-07-00, Maintenance History, Performance Criteria [2].

10.6 LIR 402-910-01, LANL Fire Protection Program

10.7 NFPA 13, 1999 Edition Standard for the Installation of Sprinkler Systems

10.8 NFPA 25, 2002 Edition Standard for the Inspection, Testing and Maintenance of Water-based Fire Protection Systems.

11.0 APPENDICES

Appendix A: Visual Inspection After Repair Checklist

APPENDIX A

VISUAL INSPECTION AFTER REPAIR CHECKLIST

1. Inspect piping and joints for proper alignment.
2. Ensure material and method of repair is acceptable.
3. Ensure pipe hangers are adequate.
4. If sprinkler heads were replaced, ensure the type meets the original specifications.